

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
14 December 2000 (14.12.2000)

PCT

(10) International Publication Number  
WO 00/74548 A1

(51) International Patent Classification<sup>7</sup>: A47L 9/16,  
B04C 3/00, 7/00

(21) International Application Number: PCT/KR00/00221

(22) International Filing Date: 16 March 2000 (16.03.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
1999/20714 4 June 1999 (04.06.1999) KR  
1999/34467 19 August 1999 (19.08.1999) KR  
1999/38110 8 September 1999 (08.09.1999) KR

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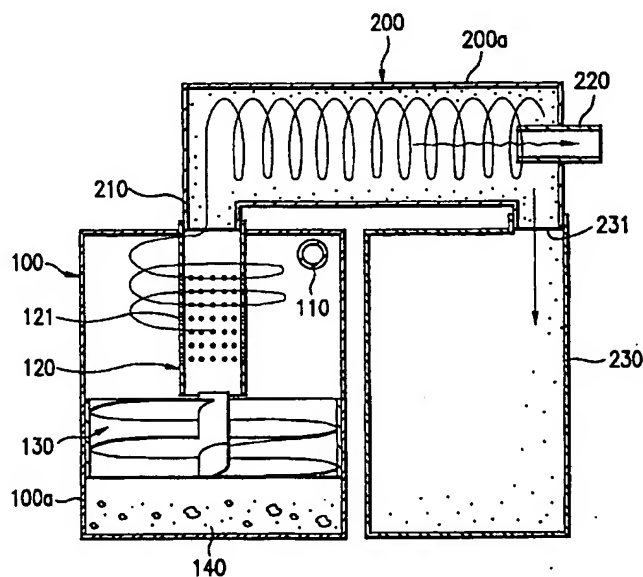
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641-091 (KR). KWAK, Dong, Jin [KR/KR]; 68-9,  
Panji-dong, Changwon-shi, Kyongsangnam-do 641-170  
(KR). LEE, Kun, Hyeong [KR/KR]; 10/2, 741-16, Kwan-  
gan 4-dong, Suyong-ku, Pusankwangyok-shi 613-104  
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(81) Designated States (national): AE, AL, AM, AT, AU, AZ,  
BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK,  
DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL,  
IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU,  
LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT,  
RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA,  
UG, US, UZ, VN, YU, ZA, ZW.

[Continued on next page]

(54) Title: MULTI-CYCLONE COLLECTOR FOR VACUUM CLEANER



(57) Abstract: Multi-cyclone collector for a vacuum cleaner including a plurality of connected cyclones each for discharging air to outside of the cyclone, and separating and collecting only contaminants from the air containing the contaminants by using a centrifugal force, wherein at least one of the multi-cyclone is a forward cyclone having substantially identical directions of air inflow and outflow, whereby reducing a pressure loss owing to an efficient reduction of a flow resistance to improve a dust collecting efficiency and to reduce a noise, and preventing reflow of the collected dust to improve the dust collection efficiency and to prevent leakage of bad smell generated from the collected dust.

WO 00/74548 A1



(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— *With international search report.*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

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Description Claims


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**MULTI-CYCLONE COLLECTOR FOR VACUUM CLEANER** Technical Field The present invention relates to a cyclone collector, more particularly, to a multi-cyclone collector having a plurality of connected collectors, and more particularly, to a multi-cyclone collector suitable for use in a vacuum cleaner.

**Background of the Related Art** The cyclone dust collector is a dust collector for collecting contaminants (dust, string pieces, paper pieces and the like) by using a cyclone principle. The cyclone collector is used in different fields, and used as a vacuum cleaner, domestically. In the cyclone collectors, there are a cyclone collector (hereafter called as, "forward cyclone collector") having substantially same flow directions of air containing the contaminants (hereafter called as, "contaminated air") and cleaned air, and a cyclone collector (hereafter called as, "backward cyclone collector") having opposite flow directions of air containing the contaminants and a cleaned air. And, in order to improve a dust collecting performance, a multi-cyclone collector is used, wherein in general a plurality of cyclone collectors are connected in parallel/series.

A related art multi-cyclone collector will be explained with reference to FIG. 1.

Referring to FIG. 1, the related art multi-cyclone collector 1 is provided with a cyclone 10 (hereafter called as, "a first cyclone") having an inlet 11 for drawing contaminated air, and a cyclone (hereafter called as, "second cyclone") 20 connected with the first cyclone 10 and having an outlet 22 for discharging cleaned air. The first cyclone 10 and the second cyclone 20 form a backward cyclone collector. First, with regard to the first cyclone 10, there is a first inlet 11 in a top of a first cyclone body (hereafter called as, a "first body") 10a for drawing air in a tangential direction, and a first outlet 12 at a center of the first body 10a for discharging cleaned air. And, there is a filter 12A provided to an entrance side of the first outlet 12 for preventing discharge of large sized contaminants. Similar to the first cyclone 10, the second cyclone 20 is provided with a second inlet 21 in a second cyclone body (hereafter called as, a "second body") 20a for drawing air, and a second outlet 22 for discharging cleaned air. Of course, the second inlet 21 is connected with the first outlet 12 in the first cyclone 10, for drawing the air and fine dust from the first cyclone 10. In the meantime, there is a suction force generating means (not shown) connected to the second outlet 22 in the second cyclone for drawing external contaminated air into the multi-cyclone collector, which may be, in general, means using a suction force of a fan following driving of a motor, an explanation and a drawing of which will be omitted since the means are known widely.

The operation of the related art multi-cyclone collector will be explained.

When the suction force generating means, for example, a suction fan in a vacuum cleaner is driven as the multi-cyclone collector is put into operation, external contaminated air is drawn into the first cyclone 10 through the first inlet 11 in a tangential direction and circulated along an inside wall surface of the first body 10a, during which process the contaminants are separated by a centrifugal force. In this instance, comparatively heavy contaminants are dropped, and collected in a lower portion of the first body 10a, and fine dust not separated is circulated inside of the first body 10a until the fine dust is discharged to the second cyclone 20 through the first outlet 12.

In the meantime, the air containing the fine dust discharged through the first outlet 12 in the first cyclone enters into the second body 20a through the second inlet 21. Accordingly, the contaminants are separated in the second cyclone once more, and a cleaned air is discharge through the second outlet 22.

Besides the foregoing cyclone dust collectors, there are different types of dust collectors suggested in USP 4643748, USP 4353008, USP 5078761, and USP 145499. The US patents disclose a multi-cyclone dust collector in which the second cyclone is disposed in the first cyclone for reducing a size of the multi-cyclone collector.

However, the related art multi-cyclone collector has the following problems.

First, the successive use of the backward cyclone collectors in the related art multi- cyclone collector causes a great total pressure loss, that in turn causes a drop of dust collecting efficiency and louder noise. This is because the backward cyclone collector has opposite directions of the contaminated air inflow and cleaned air outflow, to cause collision and interference of air flows in a process the air inflow is turned into a discharging current, an ascending air current, formed along a center line of the outlet at an end of circulation.

Second, the related art cyclone collector has a problem in that sheets of vinyl, paper, or the like, which have no weight but large sized, are attached to the first outlet of the first cyclone.

That is, the clogging of the first outlet by such a contaminant puts the cyclone collector inoperative, or causes a serious pressure drop, if the cyclone collector is operative.

Third, the related art multi-cyclone dust collector has a problem in that the fine dust failed to be collected at the first cyclone is, not discharge into the second cyclone, but kept circulating inside of the first body. This is because the contaminants separated at the first cyclone is left on a bottom of the first body by friction and weight, of which fine dust is liable to fly upward laden on the ascending current. In this instance, a portion of the fine dust enters not into the second cyclone, but keeps circulating inside of the first cyclone body, which causes a static electricity due to friction between the fine dust and the first body, that attaches the fine dust to an inside wall of the first body, which caused drop a dust collecting efficiency.

Disclosure of Invention Accordingly, the present invention is directed to a multi-cyclone collector for a vacuum cleaner that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a multi-cyclone collector for a vacuum cleaner, which can reduce a flow resistance for reducing a pressure loss and noise.

Other object OFTHE present invention is to provide a multi-cyclone collector for a vacuum cleaner, which can improve a centrifugal force, for increasing a dust collecting efficiency.

Another object of the present invention is to provide a multi-cyclone collector for a vacuum cleaner, which can prevent continuous circulation of the fine dust for improving a dust collecting efficiency.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of

the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, the multi-cyclone collector for a vacuum cleaner includes a plurality of connected cyclones each for discharging air to outside of the cyclone, and separating and collecting only contaminants from the air containing the contaminants by using a centrifugal force, wherein at least one of the multi-cyclone is a forward cyclone having substantially identical directions of air inflow and outflow.

In other aspect of the present invention, there is provided a multi-cyclone collector for a vacuum cleaner including a first cyclone having a first body for collecting contaminants separated by a centrifugal force in a lower portion thereof by means of friction and weight, a first inlet formed in an upper portion of the first body in a tangential direction for drawing contaminated air, and a first outlet formed in an axial direction in the upper portion of the first body for discharge of the air cleaned, primarily, and a second cyclone having a second body mounted substantially vertical to the first body, a second inlet formed in one side of the second body in a tangential direction and in communication with the first outlet, a first outlet formed in an axial direction in an opposite region of the second inlet, and a dust collecting box formed in a tangential direction in a region the first outlet is formed.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

**BRIEF DESCRIPTION OF THE DRAWINGS** The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention: In the drawings: FIG. 1 illustrates a section of a related art multi-cyclone dust collector; FIG. 2 illustrates a section of a multi-cyclone dust collector in accordance with a first preferred embodiment of the present invention; FIG. 3 illustrates a section of a multi-cyclone dust collector in accordance with a second preferred embodiment of the present invention; FIG. 4 illustrates a section of a multi-cyclone dust collector in accordance with a third preferred embodiment of the present invention; FIG. 5 illustrates a section of a multi-cyclone dust collector in accordance with a fourth preferred embodiment of the present invention; FIG. 6 illustrates a perspective enlarged view of "A" part in FIG. 5; FIGS. 7A-7C ILLUSTRATE perspective views of variations of the laminar flow means in FIG. 6; and, FIG. 8 illustrates a section of a multi-cyclone dust collector in accordance with a fifth preferred embodiment of the present invention.

**Best Mode for Carrying Out the Invention** Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. FIG. 2 illustrates a section of a multi-cyclone dust collector in accordance with a first preferred embodiment of the present invention, referring to which a first preferred embodiment of the present invention will be explained. The present invention suggests as a second cyclone, not the backward cyclone collector, but the forward cyclone collector, for reducing the pressure loss of the multi-cyclone collector to the maximum and improving a dust collecting efficiency by providing at least one forward cyclone, which has

comparatively low pressure loss, among the multi-cyclones. A first cyclone 100 and a second cyclone 200 will be explained in detail.

The first cyclone 100 has a system similar to the related art. That is, there is a first inlet 110 in one side of an upper portion of the first body 100A, and a first outlet 120 in top center of the first body 100A connected to the second cyclone through the first body. It is preferable that the first outlet 120 consists of perforation of holes for preventing carrying over of large sized contaminants into the second cyclone through the first outlet among the contaminants introduced into the first body 100A. In this instance, it is preferable that there are no holes 121 in an upper portion and a lower portion of the first outlet 120. Because the no provision of the holes in the upper portion can prevent the air introduced through the first inlet 110 from being discharged into the second cyclone directly without being FILTERED, and can enhance a circulating power when the contaminated air is introduced into the first body 100A. And, because the no provision of the holes in the lower portion can prevent collected dust in a lower portion of the first body from being influenced by a suction power transmitted through the perforation of the first outlet, that prevents the collected dust from being re-flown. In the meantime, it is preferable that partition means is provided in a lower portion of the first body 100A for separating a space for circulation of the air and a space for collecting dust (hereafter called as, "first dust collecting part"). The partition means may be helical blades 130, or a plate having air openings, for smooth collection of dust and efficient prevention of re-fly of the collected dust.

Next, the second cyclone 200 of a forward cyclone type different from the related art will be explained. It is preferable that a second body 200a is mounted substantially at a right angle to the first body 100A. The second body 200a has a second inlet 210 in communication with the first outlet 120 in one side thereof in a direction tangential to the second body, a second outlet 220 in the other side thereof in an axis direction, and a contaminant discharge hole 231 in the other side thereof (a direction the second outlet is provided), to which a second dust collecting part 230 is connected. Though the foregoing embodiment shows and explains a cyclone collecting including a first cyclone of a backward cyclone type and a second cyclone of a forward cyclone type, the present invention is not limited to this. That is, both the first and second cyclones may be the forward cyclone type, or the first cyclone may be the forward cyclone and the second cyclone may be the backward cyclone type.

The operation of the foregoing multi-cyclone collector in accordance with a first preferred embodiment of the present invention will be explained.

When the multi-cyclone collector is put into operation, the suction force generating means (not shown) generates a suction force, to draw contaminated air into the first body 100A through the first inlet 110. In this instance, as the contaminated air is drawn into the first body 100A in a direction tangential to the first body, the contaminated air becomes to have a circulating force which separate comparatively heavier contaminants from the air. The separated contaminants are collected in a lower portion of the first body 100A, i. e., in the first dust collecting portion 140, and fine dust which is not collected yet and air is discharged into the second inlet 210 through the first outlet 120. In this instance, the contaminants larger than the size of the holes 121 in the first outlet are collected in the first body 100A, and the fine dust and the air is introduced into the second cyclone 200 through the first outlet 120 and the second inlet 210. And, even if pieces of paper or vinyl floating in the first body 100A clogs a portion of the perforation of holes 121 of the first outlet 120, smooth discharge of the air and dust can be made through rest of the holes 121. On the other hand, the contaminants

separated in the first cyclone 100 drop to the lower portion of the first body LOOA, guided by the helical blades 130, and collected smoothly in the first dust collecting portion 140. The helical blades 130 serves, not only to guide the separated contaminants to the first dust collecting portion 140, but also to prevent the collected contaminants from be re-flown. Accordingly, the generation of the static electricity caused by re-fly of the contaminants collected in the first dust collecting portion 140 can be prevented, effectively. On the other hand, the air and the fine dust discharged into the second cyclone 200 through the first discharge outlet 120 of the first cyclone 100 is drawn into the second body 200 through the second inlet 210, and become to have a circulating force in a course of being drawn into the second body 200a. According to this, the air and fine dust have a centrifugal force exerted thereon, to lead the air being discharged to outside of the second body 200 through the second outlet 220, and the fine dust to circulate along an inside wall of the second body 200 until the fine dust is collected in the second dust collecting portion 230 through the contaminant discharge hole 231 in the second body 200a.

According to the foregoing embodiment of the present invention, the use of forward type cyclone as the first cyclone permits to reduce a pressure loss effectively in comparison to the related art. It is verified from an experiment that the use of forward type cyclone as the first cyclone in the foregoing embodiment causes a pressure loss OF APPROX. 350-450mmAq, which is a significant reduction from the related art in which a pressure loss OF APPROX. 600-850MMAQ is occurred when an air flow rate is 1.2CMM.

In the meantime, though the foregoing embodiment shows and explains a cyclone collector in which a circulation is generated by disposing the second inlet of the second cyclone in a direction tangential to the second body, the present invention is not limited to this. That is, circulation generation means may be provided in the second body 200 for circulating the air coming from the first outlet. There have been a variety of the circulation generation means suggested, of which explanation will be omitted. And, as shown in FIG. 2, it is preferable that the second dust collecting portion 230 of the second cyclone is mounted at a side of the first body 100A considering an overall shape of the multi-cyclone collector, the present invention is not limited to this.

FIG. 3 illustrates a section of a multi-cyclone dust collector in accordance with a second preferred embodiment of the present invention, referring to which the second embodiment of the present invention will be explained. As a basic system of the second embodiment is identical to the first embodiment, parts of the second embodiment identical to the first embodiment will be given identical reference numbers, and explanation of which will be omitted. The second embodiment cyclone collector has two air outlets 220 and 220a and two dust collecting boxes 230 and 230a in the second cyclone. That is, the second outlets 220 and 220a are provided on both sides of the second body 200a for splitting and discharging the air introduced into the second cyclone 200 from the first cyclone 100 to outside of the second body 200a. In this instance, it is preferable that the second inlet 210 connected to the first cyclone 100 is positioned at a center of the second body 200a, and the contaminant discharge hole 231 and 231A are positioned on opposite sides of the second body 200a.

FIG. 4 illustrates a section of a multi-cyclone dust collector in accordance with a third preferred embodiment of the present invention, referring to which the third preferred embodiment of the present invention will be explained. A basic system of the third embodiment of the present invention is identical to the first embodiment, except that the third embodiment has a first outlet 120 extended down to a bottom of the first body, with the

separate helical blades dispensed with.

In the third embodiment, it is preferable that a length of the lower portion of the first outlet 120 where no perforation of holes 121 are formed therein should be determined considering a height at which the contaminants can be collected.

FIG. 5 illustrates a section of a multi-cyclone dust collector in accordance with a fourth preferred embodiment of the present invention, and FIG. 6 illustrates a perspective enlarged view of "A" part in FIG. 5, referring to which the fourth embodiment of the present invention will be explained. As a basic system of the fourth embodiment is similar to the first embodiment, parts of the fourth embodiment identical to the first embodiment will be given identical reference numbers, and explanation of which will be omitted.

There are different means provided to the second cyclone 200 for efficient reduction of a pressure loss and noise by reducing a flow resistance. In detail, there is a flow interference prevention part 602 provided to a place opposite to the second outlet 220 for preventing an interference between the circulation and a discharging current. That is, the flow interference prevention part 602 is fitted to a side of the second body 200a opposite to the second outlet 220, i. e., a second inlet side 210. It is preferable that the flow interference prevention part 602 has a shape which becomes gradually the greater as it goes from an air inlet side toward an air outlet side because the shape can guide the air the more smoother toward the inside wall surface of the second body as it goes from the inlet side to the outlet side and prevent interference between the circulation and the discharging current. Any shape of the flow interference prevention part 602 is acceptable as far as the shape has a feature that the size gradually becomes the greater as it goes from the air inlet side to the air outlet side, such as a funnel, trumpet, semispherical, or skirt.

And, it is preferable that there is a guide part 604 for smoother guide of the air coming from the second inlet 210 toward an inside wall of the second body 200a. The guide part 604 preferably has a cylindrical form for smoother guide of the air toward an inside wall of the second body 200a.

In the meantime, it is preferable that there is laminar flow means 606 in front of the flow interference prevention part 602 for reducing the circulation force of the air to form a laminar flow. As shown in FIGS. 7A-7C, there can be a variety of the laminar flow means. For example, the laminar flow means 606 has a plurality of blades 606a in an axial direction.

In the meantime, it is preferable that there is a supplementary dust collecting box 610 at one side of the first body 100a in communication with an upper portion of the first body 100a, for efficient collection of fine dust, not collected in the lower portion of the first body 100a, but re-flown. The dust collecting box 730 and the supplementary dust collecting box 610 may or may not be formed as one unit.

The operation of the embodiment will be explained.

OF THE contaminants entered into the first cyclone 100, comparatively heavy contaminants are collected in the lower portion of the first body 100a, and the fine dust is flying again by the discharge current and the like. The fine dust re-flown to float inside of the first body 100a is collected in the supplementary dust collecting box 610, thereby permitting generation of a static electricity caused by the floatation of the fine dust. The air flowing



from the first cyclone 100 to the second cyclone 200 is guided toward an inside wall of the second body 200a of the second cyclone 200 by the guide part 604. And, since the flow interference prevention means has a form in which a diameter thereof becomes gradually the greater as it goes toward an air outlet side from an air inlet side, the contaminated air is directed toward the inside wall of the second body 200a the more efficiently. That is, since the guide part and the flow interference prevention part enhance direction of the air introduced into the second cyclone 200 toward the inside wall of the second body 200a, the embodiment of the present invention can improve a dust collecting efficiency. And, in this embodiment, since the flow interference prevention part 602 guides the air flow toward the inside wall of the second body 200a and shields an influence of the air discharge pressure to the circulation, the contaminants can be prevented from being carried on the discharged air, and discharged direct to the second outlet, without being flown toward the inside wall of the second body, effectively. And, since the air flow is turned into a laminar flow as the air flow meets with the blades of the laminal flow means 606 and involved in a circulation force reduction during discharge of the air, a pressure drop and noise caused by occurrence of a turbulent flow can be reduced effectively. It has been verified from an experiment that there is a significant reduction of a pressure loss, as this embodiment shows a pressure loss OF APPROX.

265 WHILE the related art shows a pressure loss OF APPROX. 600-850MMAQ when an air flow rate is 1.2CMM. It has been also verified that the embodiment shows a pressure loss even in comparison to the first embodiment.

FIG. 8 illustrates a section of a multi-cyclone dust collector in accordance with a fifth preferred embodiment of the present invention, referring to which the fifth embodiment of the present invention will be explained. This embodiment is obtained by paying attention to a fact that use of the flow interference prevention part, the laminar flow means, and the supplementary dust collecting box in the fourth embodiment in the backward cyclone collector for improving a dust collecting efficiency can provide an identical effect. That is, in this embodiment, the flow interference prevention part, the laminar flow means, and the supplementary dust collecting box are applied to the second cyclone of a backward cyclone type. Explanation for the first cyclone 100 will be omitted as the first cyclone 100 of the embodiment is similar to the first embodiment.

In the second cyclone 700 of this embodiment, there is a second inlet 710 and a second outlet 720 in one side of the second body 700a, and a dust collecting box 730 in the other side of the second body 700a. And, there is flow interference prevention part 602 and the guide part 604 at a place opposite to the second outlet 720, i. e., the dust collecting box 730 is provided. And, there is a supplementary dust collecting box 610 at an upper side of the first body LOOA. The dust collecting box 730 and the supplementary dust collecting box 610 may or may not be formed as a unit. Since the operation principle of the embodiment is similar to the fourth embodiment, explanation for the same will be omitted.

The cyclone collector of the present invention can be used as a body of a canister type vacuum cleaner or at a extension pipe, or applicable to an upright type cleaner.

As has been explained, the multi-cyclone collector of the present invention has the following advantages.

First, the reduction of pressure loss coming from an efficient reduction of a flow resistance

permits to improve a dust collecting efficiency and to reduce a noise.

Second, the prevention of re-fly of the collected dust permits to improve the dust collection efficiency and to prevent leakage of smell generated from the collected dust.

It will be apparent to those skilled in the art that various modifications and variations can be made in the multi-cyclone collector of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

#### Description Claims

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What is Claimed is: 1. A multi-cyclone collector for a vacuum cleaner comprising: a plurality of connected cyclones each for discharging air to outside of the cyclone, and separating and collecting only contaminants from the air containing the contaminants by using a centrifugal force, wherein at least one of the multi-cyclone is a forward cyclone having substantially identical directions of air inflow and outflow.

2. A multi-cyclone collector for a vacuum cleaner comprising: a first cyclone having a first body for collecting contaminants separated by a centrifugal force in a lower portion thereof by means of friction and weight, a first inlet formed in an upper portion of the first body in a tangential direction for drawing contaminated air, and a first outlet formed in an axial direction in the upper portion of the first body for discharge of the air cleaned, primarily; and, a second cyclone having a second body mounted substantially vertical to the first body, a second inlet formed in one side of the second body in a tangential direction and in communication with the first outlet, a first outlet formed in an axial direction in an opposite region of the second inlet, and a dust collecting box formed in a tangential direction in a region the first outlet is formed.

3. A multi-cyclone collector as claimed in claim 2, further comprising a flow interference prevention part having a shape in which a diameter becomes the greater as it goes toward the second outlet direction the more, the flow interference prevention part being disposed at a place opposite to the second outlet in the second body.

4. A multi-cyclone collector as claimed in claim 3, further comprising laminar flow means in front of the flow interference prevention part for removing circulating force of the discharge air.

5. A multi-cyclone collector as claimed in claim 4, further comprising a supplementary dust collecting box at a side of the first body in communication with an upper portion of the first body for collecting fine dust.

6. A multi-cyclone collector for a vacuum cleaner comprising: a first cyclone having a first body for collecting contaminants separated by a centrifugal force in a lower portion thereof by means of friction and weight, a first inlet formed in an upper portion of the first body in a tangential direction for drawing contaminated air, and a first outlet formed in an axial direction in the upper portion of the first body for discharge of the air cleaned, primarily; and, a second cyclone having a second body mounted substantially vertical to the first body, a second inlet formed in one side of the second body in a tangential direction and in

communication with the first outlet, a second outlet formed in an axial direction in a region substantially identical to the second inlet, and a dust collecting box formed in a tangential direction in a region opposite to the second outlet.

7. A multi-cyclone collector as claimed in claim 7, further comprising a flow interference prevention part having a shape in which a diameter becomes the greater as it goes toward the second outlet direction the more, the flow interference prevention part being disposed at a place opposite to the second outlet in the second body.

8. A multi-cyclone collector as claimed in claim 7, further comprising laminar flow means in front of the flow interference prevention part for removing circulating force of the discharge air.

9. A multi-cyclone collector as claimed in claim 8, further comprising a supplementary dust collecting box at a side of the first body in communication with an upper portion of the first body for collecting fine dust.

Description Claims

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/KR00/00221

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC7 A47L 9/16, B04C 3/00, B04C 7/00**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 A47L 9/16, B04C 3/00, B04C 7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR IPC as above

JP IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5090976 (NOTETRY LTD.) 25 February 1992 (25. 02. 92) see Fig. 1, 3.	1.
Y	US, A, 4853008 (NOTETRY LTD.) 01 August 1989 (01. 08. 89) see Fig. 1, 2, 3, 4.	1
Y	JP, A, 51-67581 (TOPII KOGYO KK) 11 June 1976 (11. 06. 76) see Fig. 1, 2.	1 (Family none)
A	JP, A, 52-38679 (TOKYO TAKAHASHI) 25 March 1977 (25. 03. 77) see Fig. 1.	1 (Family none)

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

24 JUNE 2000 (24.06.2000)

Date of mailing of the international search report

29 JUNE 2000 (29.06.2000)

Name and mailing address of the ISA/KR

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

PCT/KR00/00221

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